VTT Technical Research Centre of Finland

VTT Sustainable Good Life Exhibition E-Book

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What is VTT Sustainable Good Life Exhibition all about?

Helsinki Fashion Week (HFW) took its visitors on a journey of Finnish life, fashion, design and wellbeing with sustainability at its core. VTT Technical Research Centre of Finland Ltd partnered with HFW and created the VTT Sustainable Good Life Exhibition which was a part of the HFW EcoVillage concept. Our exhibition is a unique experience of the living world where circular economy and sustainable values are the basis for every aspect of human existence. This green world concept is demonstrated as a platform that enables connection and co-creation between industries and research institutions, ongoing dialog with consumers and creative approach to technological innovation. This approach makes it possible to develop and establish novel nature-friendly value chains leading to zero-waste society.

VTT Technical Research Centre of Finland is one of the leading research and technology organisations in Europe. Our research and innovation services give our partners, both private and public, all over the world a competitive edge. We pave the way for the future by developing new smart technologies, profitable solutions and innovation services.

We create technology that goes beyond the obvious – for the benefit of society.

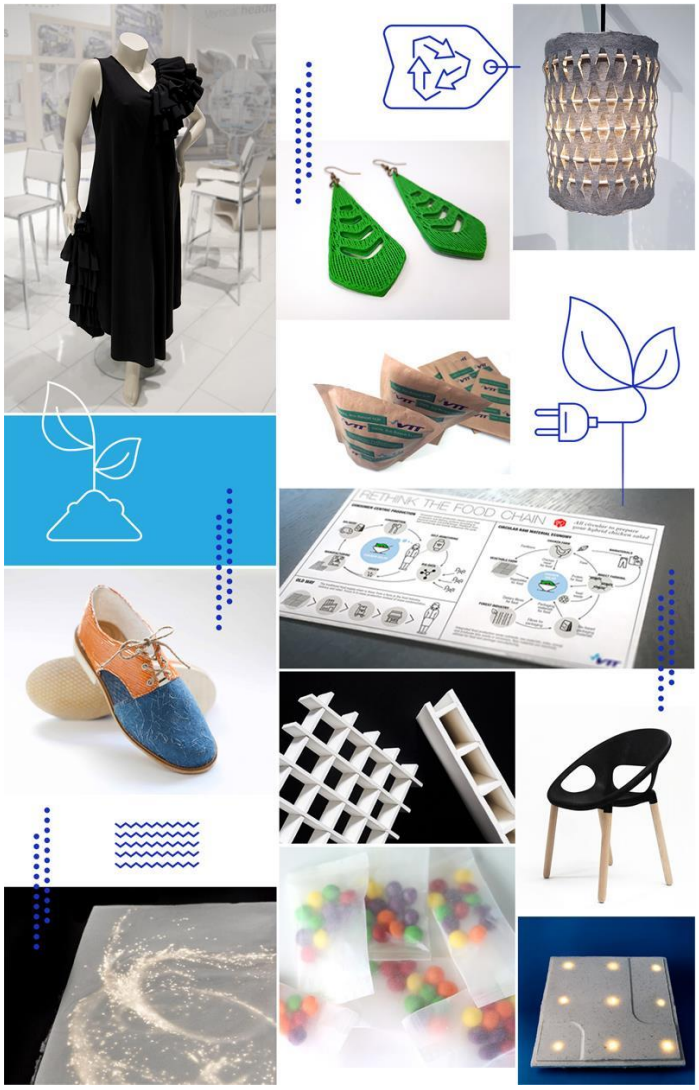
"*Sustainable future is built in collaboration,*
design brings the technologies we create alive"
Tiina Nakari-Setälä
Vice President Research, VTT

VTT
beyond
the obvious

How to look great, live great and feel great with minimum environmental impact?

VTT has grouped the vision of the future of everyday life into modules called “LOOK”, “LIVE” and “FEEL”. The modules addresses human experiences and the environmental impact they create. The exhibition questions the conventional ways of material consumption and disposal, while demonstrating sustainable alternatives based on the latest research and innovation outcomes provided by VTT and its partners. We want to address the big questions of how can you look great, live great and feel great with minimum impact on the environment.

Visitors were invited on an adventure of seeing, touching, smelling and listening to the variety of biobased solutions created for living environment - from every stage of the development process: from exclusive laboratory scale prototypes and samples to commercially available products.



VTT has a long history researching and developing natural and man-made fibres, nanocellulose, biopolymers, composite and foam technologies. Many of the biobased innovations showcased in the Sustainable Good Life Exhibition are cellulose-based, for example a great example of everyday life material like paper is made out of cellulose. Cellulose is the most abundant organic polymer on Earth, it can be sourced for example from sustainably managed forests or agricultural waste. With all the potential applications, it is a real super material.

LOOK great

What if the clothes and shoes we wear didn’t cause harmful microplastics? Would they still be comfortable, stylish, durable and affordable for everyone? This module displays innovations in the field of textile recycling, all-wood based material solutions for footwear as well as 3D printed products from nanocellulose. Have a look through the LOOK great catalogue!

CATALOGUE of LOOK great

EVENING DRESS FROM RECYCLED TEXTILES

EVENING BAG FROM BIOMATERIALS

SHOES FROM CELLULOSE-BASED MATERIALS

3D PRINTED EARRINGS FROM CELLULOSE

COMPOST TABLE

EVENING DRESS FROM RECYCLED TEXTILES

VTT, designer Anna Ruohonen / Mechanically recycled cotton combined with chemically recycled cotton

Uudenmaan liitto
Nylands förbund

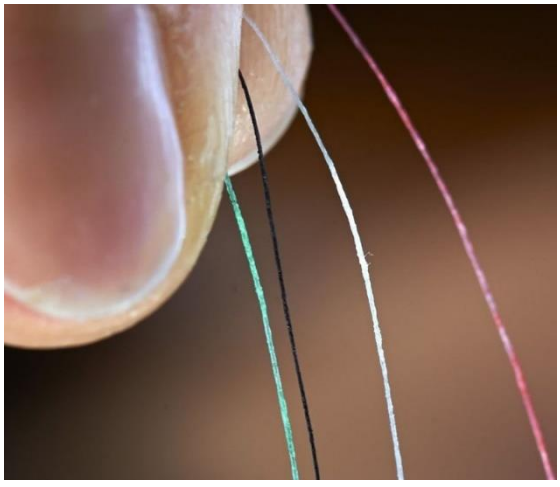
European Union
European Regional
Development Fund

The demand for textile fibres will nearly double by 2030 due to the population growth. In 2016, annual global textile production was somewhat 95 million tons. To produce that amount, 9 – 15 trillion litres of water is needed. Although cotton is a renewable resource, its cultivation requires irrigation water, arable land, fertilizers and pesticides that increase its negative environmental impact. Recycled textiles reduce need to apply virgin raw materials, like cotton.

How is it made and technology insights

The evening dress was made for MEP Sirpa Pietikäinen and she wore the dress to the Finland's Centenary Independence Day Reception at the Presidential Palace 6.12.2017. The dress is 50 % of chemically recycled cotton (cellulose carbamate made in VTT Bioruukki piloting center), and 50 % mechanically recycled cotton made by PuRe Waste.

The chemical recycling technology consists of three key processes: activation, dissolving and fractioning. With the technology, you can return the waste cotton back to new fibers. The modified fiber is equal to viscose, it has haptic and hand feel similar to cotton. We have combined the chemically recycled fibers with mechanically recycled cotton fibers into yarns to minimize product footprint. The recycled cotton is a technology platform for fibers suitable to be applied in garments and other textiles instead of cotton. The chemical recycling technology is transferred to a VTT start-up Infinited Fiber Company.



EVENING BAG FROM BIOMATERIALS

VTT, designers Anneli Auranen and Heta Kupsala

How was it made and technology insights

The biodegradable evening bag was designed for MEP Sirpa Pietikäinen and it was her accessory at the Finland's Centenary Independence Day Reception at the Presidential Palace on 6.12.2017.

Thermoplastic cellulose and polylactid acid (PLA, a bioplastic) was combined using conventional plastic processing to generate a material that is 100% biobased. The black colour is from carbon black, which can also be biosourced. The thermoplastic cellulose is a cellulose that can me melted, and has a tough and feel similar to leather and high density polyethylene. PLA is the most common commercial biopolymer which is biodegradable. In its natural state is a strong and hard polymer, but more brittle than plastics like polyethylene (PE) or polypropylene (PP). It is now found in many application areas, and prominently in 3D printing. Both thermoplastic cellulose and PLA is capable of replacing conventional plastics in a broad range of applications.

SHOES FROM CELLULOSE-BASED MATERIALS

VTT, designer Saara Kinnunen

Technical insights

The all-cellulose shoes were created by utilizing several different technologies and cellulose-based materials. The upper part of the shoes is made out of non-woven from pulp and pulp yarn and viscose, produced by foam forming. The orange material, which is leather-like texture and gives support to the shoe, is cellulose derivate, which is 3D printed on the surface. The heel is made out of veneer, which is glued together with CatLignin. The outsole is thermoformable cellulose derivative.

3D PRINTED EARRINGS FROM CELLULOSE

VTT, designer Anastasia Ivanova

"These are really light and do not weigh down the ears. The earrings can still be further developed to make them more endurable."
Anastasia Ivanova

Technical insights

The earrings have been 3D printed from biobased hydrogel and dyed with green leaf dye.

Printable paste has been produced in three steps and then printed. The final object has been dried in room temperature. Material can be rigid or elastic, can include dyes, magnetic or electrical properties. Material can be utilized for example in mock-ups, rapid prototyping, composite applications and interior decoration.

COMPOST TABLE

Do you ever wonder what happens to a milk carton lying alongside the road or waste textiles that end up in the nature?

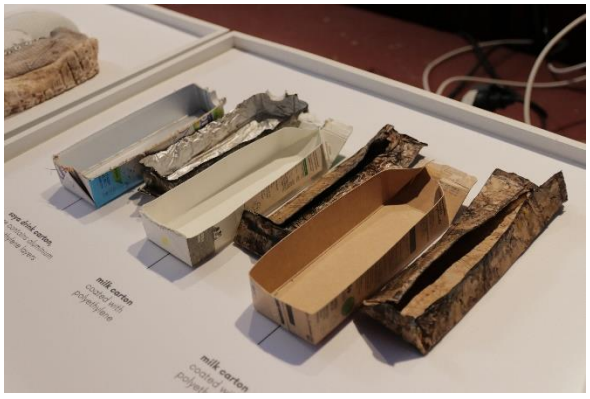
VTT conducted an experiment for the Sustainable Good Life Exhibition to study degradation of commonly used packaging materials and textiles. The experiment was performed in a composting facility where conditions were optimal for degradation. Four to five weeks of our composting experiment equals several months to even years of exposure in the natural environment, such as being thrown into the forest. A number of textile samples, a shoe and several packaging solutions were studied for their biodegradability. Below are the outcomes of the biodegradation experiments on textiles (1) and packaging materials (2).

1. Biodegrading of textiles

During the experiment cellulose-based viscose degraded completely and cotton almost completely in five weeks; at the same time cellulose acetate and synthetic materials like polyester and nylon did not degrade during the experiment. Cellulose carbamate manufactured by VTT's newly developed technology degraded partly in the studied time.

2. Biodegrading of packaging

The results of the experiment showed that uncoated cardboard degraded completely already in four weeks. If packaging material contained polyethylene or aluminum, these components remained undegraded after five weeks of composting.



CATALOGUE of FEEL great

What are the flavors and vibes of the future? Innovations by VTT and recently developed commercial products by our partners prove that zero-waste society could be reality of today, and that you do not need to compromise your comfort to join the adventure of sustainable life.

CATALOGUE of FEEL great

FOOD of THE FUTURE

BIOBASED PACKAGING SOLUTION

COMMERCIAL PRODUCTS of VTT’s PARTNERS

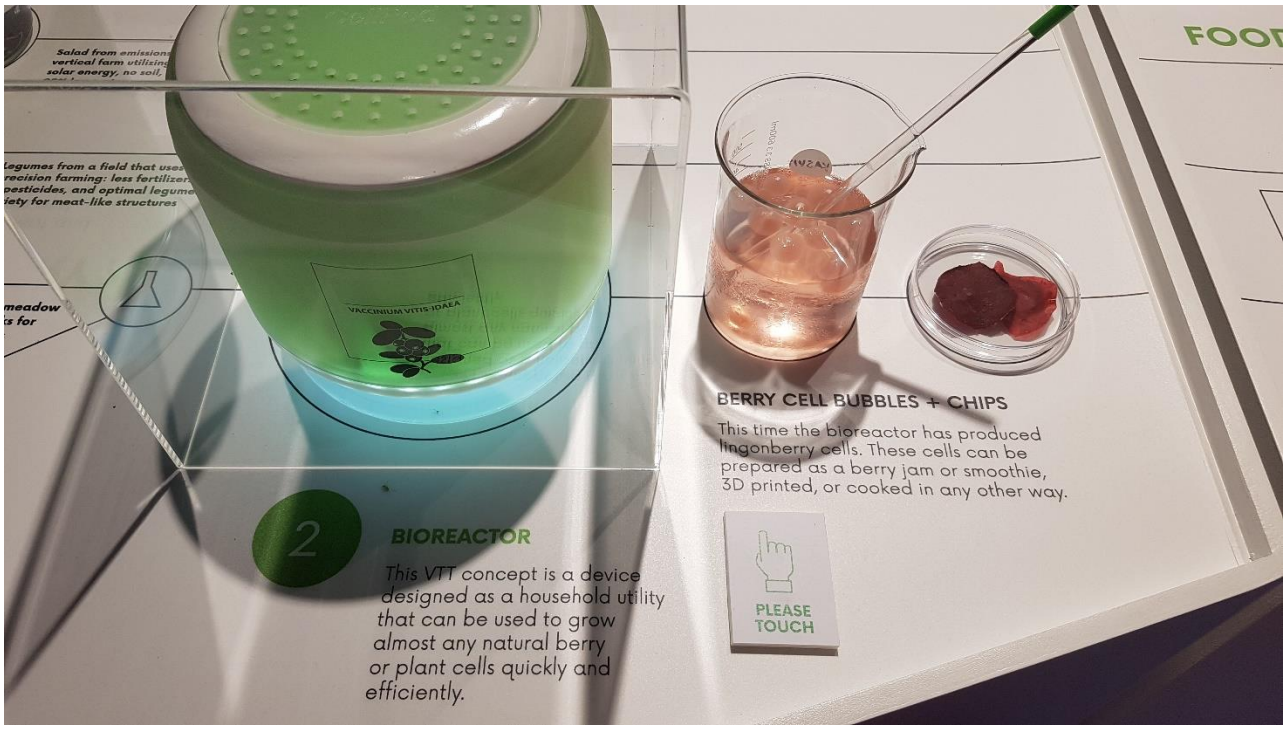
FOOD OF THE FUTURE - Wellbeing for me and the planet

VTT

Innovative plant proteins

The current trends in the food market, health and well-being and increasing consciousness on the part of consumers regarding sustainability of food production creates a need for new domestic plant-based protein ingredients. VTT has focused on the utilization of the domestic European plant raw materials and side streams such as faba beans, oats, barley, cereal brans and oil press cakes for protein extraction. All these raw material sources have a natural image, are GMO free and their extraction steps are simple and green consisting of mechanical fractionation and further bioprocessing. Based on combinations of bioprocessing, thermo-mechanical processing, wet or dry fractionation and supercritical carbon dioxide (SC-CO2) extraction technologies, VTT has developed methods to concentrate protein from plant materials and their side-streams into fractions having improved nutritional, techno-functional and sensory properties.

Arctic Plant Cells Fresh From Your Kitchen



Urban dwellers are hungry for fresh and healthy foods, while being increasingly aware of the sustainability of food production. Getting involved in the production of food is also an emerging trend: consumers are becoming prosumers, meaning that they want to take part in the food production process themselves. Many plants found in the Arctic are of interest to global markets, but cannot be foraged or cultivated at large scale. Growing the plant cells in contained bioreactors avoids over-harvesting of wild plants and excess use of agrochemicals, arable land, potable water or fertilizers in agriculture. Furthermore, VTT's home bioreactor concept enables anyone to grow plant cells, fresh at home. Food production becomes independent of seasons, geographical area and political situations while being sustainable and environmentally sound. The home bioreactor is the first bioreactor designed to bring cellular agriculture to the home environment and into the hands of the end-user. The home reactor prototype is developed further towards commercialization.

In the Sustainable Good Life Exhibition, lingonberry cells, chips and jam were showcased. Also samples of 3D printed food, sort of hybrid croutons, were on display.

Creating multifunctional food ingredients from wood

Consumers as well as the food industry demand food products that are healthy, safe, natural and have a long shelf-life. Many of these functionalities can be achieved with wood-based ingredients. Cellulosic, hemicellulosic and lignin fractions from wood possess unique properties, such as thickening, film-forming, emulsifying, emulsion stabilizing and antioxidant characteristics that are exactly the same functional properties that the food industry seeks for their products. The proof-of-concepts performed recently at VTT illustrate that wood-based fibrillar cellulose is a promising hydrocolloid to tailor the viscosity and stability of dairy products.

BIOBASED PACKAGING SOLUTION

VTT

This 100 % renewable and biobased food packaging solution looks like plastic and performs like plastic, but is not plastic – it is made out of Mother Nature's very own raw material of cellulose. VTT's biobased packaging solution offers an alternative to plastic packaging. The packaging solution has been awarded by Ellen MacArthur Foundation in January 2018, won the EcoPack Challenge 2018 and is one of the finalists for Sustainability Awards 2018 biobased packaging category.

COMMERCIAL PACKAGING SAMPLES

In this exhibition module, our commercial partners displayed their already available sustainable products as a part of the VTT Sustainable Good Life Exhibition.

KUPILKA CUTLERY SET AND DRINKING CUP, Plasthill Ltd

FLEXIBLE PACKAGING, Paptic Ltd

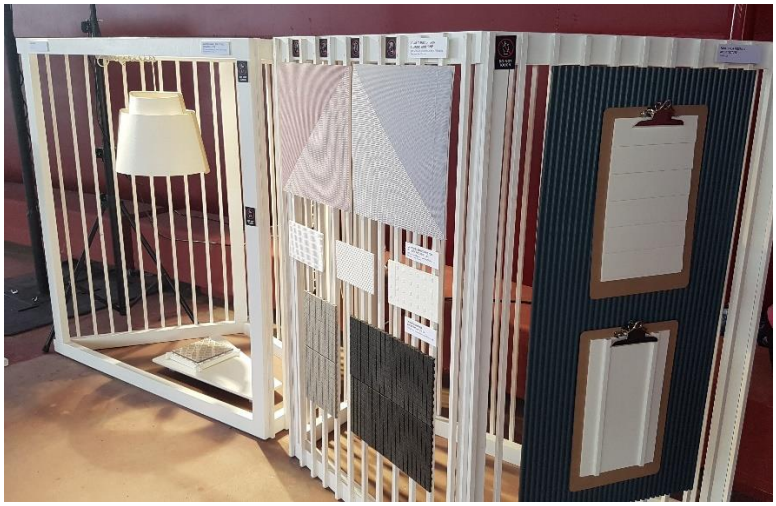
BICYCLE WITH WOODEN FRAME, Wiilubike Ltd

PACKAGING OF COSMETICS, Sulapac Ltd

PLATE, Jospak Ltd

LIVE great

Did you know that it is possible to live a sustainably in a good and enjoyable living environment with minimum carbon footprint? VTT research develops innovative solutions to apply novel wood-based materials in architecture and interiors.



CATALOGUE of LIVE great

LAMINATED STRUCTURES FOR INTERIOR ARCHITECTURE
FOAM FORMED INTERIOR ELEMENTS WITH PRINTS
PANELS FOR INTERIOR ARCHITECTURE, Wall+ Ltd
LAMPSHADE, Sukarwood Ltd

LAMINATED STRUCTURES FOR INTERIOR ARCHITECTURE

VTT, designer Heidi Turunen / Hard, solid structure of paper and nanocellulose

How is it made and technology insights

Laminated structures combine specially developed high consistency nanocellulose and porous paper structures into solid, strong and machinable shapes. Raw shapes reassemble wood-based boards with the exception of possibility to create deep patters to surfaces during manufacturing. Only two raw materials, nanocellulose and paper, are needed to create these kind of structures. All process steps needed are established industrial scale technology.

Nanocellulose, with dry solids content around 10 %, is added between individual fibre containing layers to act as glue. Individual layers are stacked together followed by wet pressing and water evaporation. Upon pressing nanocellulose saturates the porous fibre matrix, which is then solidified during drying. The structures can be finished to desired shapes using normal wood or metal working tools.

Structures have superior bending strength compared to traditional interior board structures such as chip board and mdf board. Surface can be patterned using up to 1.5 mm deep freely designed forms and the surface can be printed like paper. Less than 20% of the price of the structure is originated from nanocellulose, the paper is the largest price contributing component. These structures may serve as interior dividing walls instead of gypsum board and chipboard having superior strength. Also open office spaces may find use of these structures as dividing walls, which are light, sound absorbing, entirely biobased and biodegradable. Surfaces may be finished using desired patterns or pictures.

FOAM FORMED INTERIOR ELEMENTS WITH PRINTS

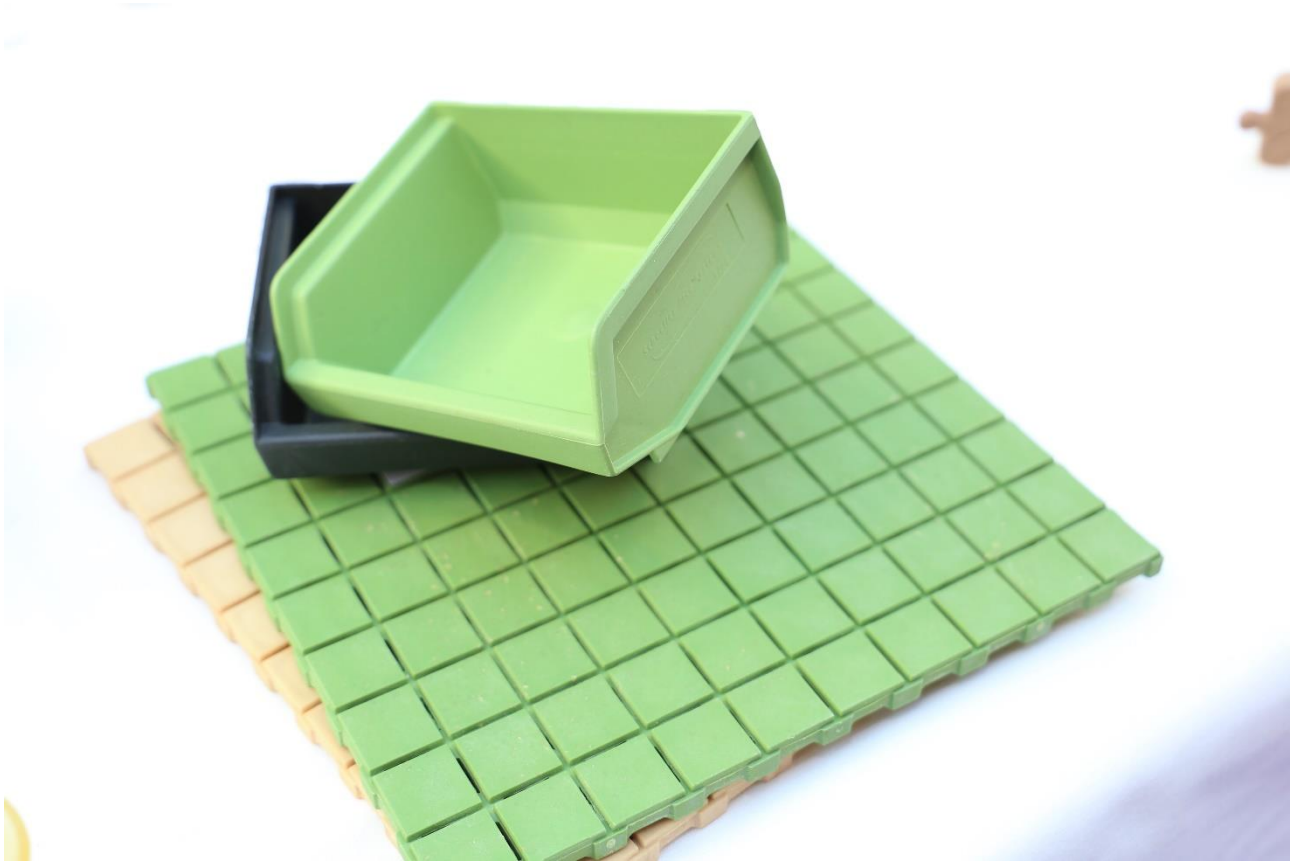
VTT, designer Heidi Turunen / Foamed softwood pulp pressed to solid board

How is it made and technology insights

Foam structures are light and the bending strength of dense foams is comparable to gypsum board strength. Dense structures may be cut to desired shapes using laser cutting or other tools used for wood or metal, porous structures using tools meant for insulation glass wool.

Foam forming enables production from large selection of natural and artificial fibre shaped materials. Foam formed interior elements contain pulp fibres and small amount of foaming agent. As dried form, foam elements may be porous or wet pressed to dense structures. Foam is created by adding small amount foaming agent to the fiber slurry followed by mixing, filtration, optional wet pressing and drying to create fibre foam. Density level of the fiber foams is adjusted by the amount of wet pressing.

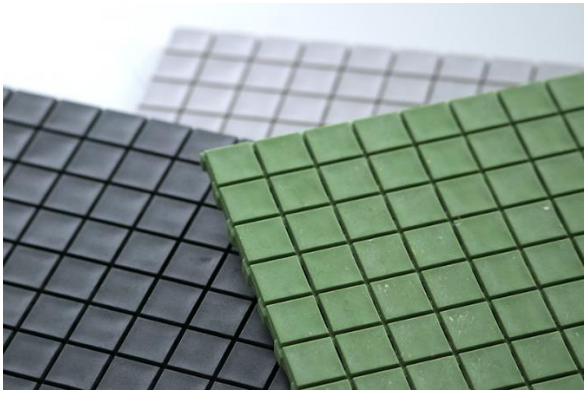
These structures may serve as interior dividing walls instead of gypsum board and chip board. Also open office spaces may find use of these structures as dividing walls, which are light, sound absorbing, entirely bio-based and bio-degradable. Surfaces may be finished using desired patterns or printed pictures.



FLOOR TILES MADE FROM SIDESTREAMS

VTT

Significant amounts of valuable components such as fibres and mineral fillers are lost in the form of industrial side streams. Global demand for sustainable products is steadily increasing and new environmental concerns and waste disposal laws are pushing the industry to find new and alternative uses for waste residues. VTT has created a composite from these side streams and thermoplastic polymers, which can be then turned into products via injection moulding or extrusion. By doing so, the benefits are improved composite properties, decreased waste generation, improved resource efficiency, reduced environmental footprint and added value is created for side streams.

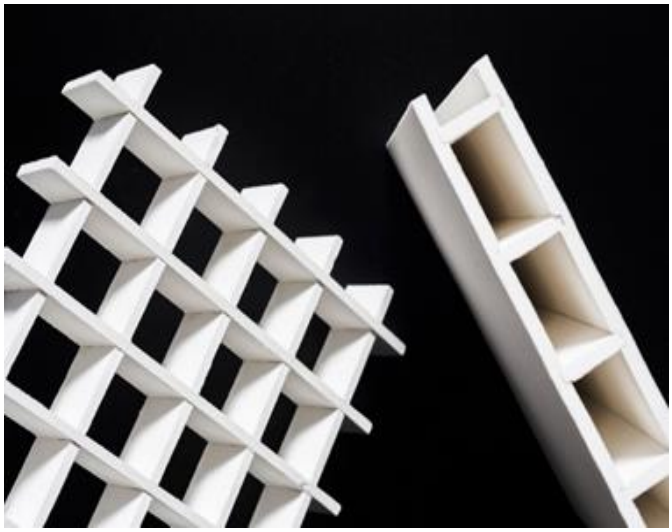


SANDWICH WALL STRUCTURES FROM CELLULOSE

VTT, designer Heidi Turunen / Foamed pulp with different densities combined

Technology insights

Foam forming enables production from large selection of natural and artificial fibre shaped materials. Foam formed interior elements contain pulp fibres and small amount of foaming agent. As dried form, foam elements may be porous or wet pressed to dense structures. Laminated structures combine specially developed high consistency nanocellulose and porous paper structures into solid, strong and machinable shapes. Raw shapes reassemble wood based boards with the exception of possibility to create deep patters to surfaces during manufacturing. These two methods may be combined with wood based products such as plywood or glued timber slabs.



Sandwich structure process follows the process steps of foam formed structures and laminated structures. These can be combined together using high consistency nanocellulose as glue. This cellulose “glue” can be added to structure surfaces using spray, brush or roller.

These structures can be used as for example interior dividing walls. Also open office spaces may find use of these structures as dividing walls which are light, sound absorbing, entirely bio-based and bio-degradable. Surfaces may be finished using desired patterns or printed pictures.

It was a pleasure to collaborate around such an important topic – our sustainable future. Thank you for all the hard work from the VTT exhibition team, Helsinki Fashion Week and our partners.

VTT exhibition team,
Vesa Kunnari, Otto-Ville Kaukoniemi, Maris Uutar, Suvi Setälä, Anastasia Ivanova, Heikki Konu, Satu Koskela, Paula Bergqvist, Ali Harlin, Tiina Nakari-Setälä, Anna Tenhunen.

Designs,
Anastasia Ivanova, Heikki Konu.

Image credits,
VTT, Suvi Setälä, Eva Suorlahti, Anastasia Ivanova, Paula Bergqvist.

On the behalf of the VTT HFW Crew,

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